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COST COMPARISON OF TECHNICAL TRAINING SCHOOL VERSUS UNIT TRAINING METHODS FOR DIRECT-DUTY AIRMEN IN CIVIL ENGINEERING AIR FORCE SPECIALTY CODES

Keith E. Smith
Captain, USAF

AFIT/GEM/LSH/86S-24

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THESIS

Presented to the Faculty of the School of Systems and
Logistics of the Air Force Institute of Technology
Air University
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Requirements for the Degree of
Master of Science in Engineering Management

Keith E. Smith, B.S.
Captain, USAF

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Preface

This study was recommended to me by Captain John Bravo from the Engineering and Services Center. He expressed concern over the number of direct-duty airmen civil engineering was responsible for training each year at the base level. It was his belief that the Air Force would save money in the long run if all airmen entering into a civil engineering AFSC were to attend technical training school. Capt Bravo asked me to perform a study using observation methods of airmen at different bases to determine methods of training, problems involved with training at base level, and to try to determine costs for the direct-duty training method and compare this cost to technical school. Capt Bravo plans to use the results of this research to decide whether an in-depth study Air Force wide should be contracted out.

I wish to thank several people for their outstanding help and patience with me during this research. First I wish to thank my wife, Carrie, and my son, Shaun, for their patience and understanding for the times I could not be with them. I wish to thank Pam Marshfield for her outstanding support in helping me to arrange both of my TDYs and pushing through my orders. I wish to finally thank my advisors, Dr. Robert Weaver and Captain Robert Luebben. Without your time and efforts I never would have figured out what it was I really wanted to do or how to do it. Thanks for your time during our long discussions when we tried to determine what

our findings were and if they were valid and conclusive. And, of course, thanks to the School of Systems and Logistics for allowing me to come here to study for my masters degree and perform this research, as well as the monetary support for my TDYs.

Keith E. Smith

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Abstract

Seven Air Force Specialty Codes (AFSC) in civil engineering are coded Category B for training. Thus 50% of all airmen entering each of these AFSCs attend technical training school, while the remaining airmen are sent direct-duty to their first assignment to be trained by the squadron. Air Force Engineering and Services Center (AFESC) believes that training airmen at the base level costs the Air Force money in the long run due to loss of productivity. First-term airmen were observed at three bases to determine if there was any difference in the proportion of productive time between technical school graduates and direct-duty airmen. Foremen and trainers were interviewed to determine training methods for the direct-duty airmen as well as any problems associated with either training method. The results of the research show that there is no significant difference between the proportions of productive times for the two training methods for years two, three, and four of the airmen's first term. There was a significant difference for airmen in their first year, with direct-duty airmen being more productive. The costs for each method were also obtained and compared. In each AFSC, the Air Force would have saved money if all airmen had been sent to technical

training school. These cost savings ranged from $18,784 to $43,508 for each airman entering one of the seven AFSCs. Based on the findings from this study, all airmen entering civil engineering should be sent to tecnnical training school.

COST COMPARISON OF TECHNICAL TRAINING SCHOOL VERSUS UNIT TRAINING METHODS FOR DIRECT-DUTY AIRMEN IN CIVIL ENGINEERING AIR FORCE SPECIALTY CODES

I. Introduction

Background

Air Training Command (ATC) currently has a program in which individuals are selected to go directly to their first duty assignment upon completion of basic training, or when cross training to a new skill, thus by-passing technical training school (2). Included in this program are airmen in seven different civil engineering specialties (9). Approximately 50% of the airmen projected for these seven Air Force Specialty Codes (AFSC) attend technical training school, while the other 50% are sent direct-duty to their first base (6,7).

Budgetary constraints are the underlying reason why all airmen in these AFSCs can not be sent to technical training school. Because of these constraints, the funds and manning positions to pay for additional instructors, as well as to pay the students while in technical training school, must come from the other major commands. Currently, the benefits gained from funding the additional positions and getting these direct-duty airmen trained at technical

school do not offset the manpower losses within each command.

The burden for training the direct-duty airmen rests with each base level unit. The squadron training NCO has overall responsibility to ensure that the airmen receive the training, with assistance from the supervisors of the direct-duty airmen. Within the civil engineering career field, seven of the eighteen entry level AFSCs use the direct-duty method. The Air Force Engineering and Services Center (AFESC) staff at Tyndall AFB, Florida, believe that these training requirements create an added burden for the squadron (1).

The staff at AFESC also suspect that the costs associated with the direct-duty method are significantly higher for the Air Force versus the costs of sending the airmen to technical training school (1). These costs are measured as productivity loss and extra training requirements at each base.

Problem Statement

The research hypothesis tested was to determine if the cost of the direct-duty training method is significantly higher than the cost of sending airmen to technical training school.

The sample population consisted of all airmen serving in their first four years of active duty at Wright-Patterson, Scott, and MacDill Air Force Bases in the following AFSCs:

AFSC	TITLE
542X0	Interior Electrician
545X0	Heating Technician
551X0	Pavement Specialist
552X0	Carpenter Apprentice
552X1	Masonry Apprentice
552X5	Plumbing Apprentice
555X0	Production Control Specialist

The following investigative questions were answered to test the hypothesis.

1. What is the projected cost of training an individual if all airmen are sent to technical training school? What are the savings, as computed by ATC, of using the direct-duty method?
2. What is the average total cost at base level to train the direct-duty airmen on the material normally taught at technical school for each of the seven civil engineering AFSCs?
3. Is there a significant difference between the average percent of productive time for the direct-duty airmen versus the technical school graduates?
4. How does the training progression of direct-duty airmen compare to that of technical school graduates

in each of the seven civil engineering AFSCs, as measured by time?

5. What are the criteria used to select airmen for the direct-duty assignment method?

Assumptions

The major assumption for this research is that there is a simple relationship between training methods and costs, especially with the direct-duty method. It is assumed that the individual training programs and habits for each training NCO and supervisor have no significant impact on costs. It is also assumed that variables associated with major commands have no significant impact on costs.

Scope Limitations

The most restrictive limitation to this research was the selection of bases in the sample. Because of constraints on time and TDY funds, the bases were Wright-Patterson, Scott, and MacDill. Wright-Patterson was chosen because of its location and size. Scott and MacDill were chosen to provide one cold weather base and one warm weather base to allow for weather differences. All bases were large enough to insure enough airmen were available for observation. Each squadron contained at least 500 personnel, with at least half being military personnel.

A second limitation was the personal interviews to gather the training costs of the direct-duty airmen. The OJT records were not completely valid because these were not signed off as completed until the end-of-course exams and other academic work were completed. The airman could have completed the competency portion of the training long before this. Many supervisors wait until all actions required for upgrade are completed prior to signing the records. Therefore the interview method was the best way to obtain training data in the amount of time available. However, the validity of this method may be suspect, since it requires the persons being interviewed to depend on their memory.

II. Literature Review

History

The method of sending airmen directly to their first duty assignment after basic training has been used for more than 25 years (4). The percentage of airmen being sent as direct-duty assignees has fluctuated over the years. The percentage of airmen graduating from basic training and being sent as direct-duty assignees peaked in the early 1970s at 19% to 20% of the total number of airmen graduating from basic training (4).

The percentage of direct-duty airmen has dropped to a current rate of 7% (4). These airmen being sent direct-duty fall into one of 31 AFSCs out of 288 entry level AFSCs (2,7). The entry level AFSCs are broken into three categories. Category C AFSCs number 15. All of the airmen in these AFSCs are direct-duty assignees. There are no technical schools for these skills (2). These AFSCs have been labeled as not needing technical training at a formal school. Because the skills required for these AFSCs are minimal, they can easily be taught at base level in a short period of time (9). One example of a Category C AFSC is 552X4, Protective Coating, an AFSC in civil engineering. Because this AFSC is being converted to all civilian, it has been excluded from this research on direct-duty costs.

Category B AFSCs are those in which 50% of the airmen go to technical school, while the rest go direct-duty (6,7). There are 16 Category B AFSCs (2). The rest of the AFSC'S are classified as Category A. All of the airmen in these Category A AFSCs attend technical training school prior to their first assignment (2).

Selection Process

In the Category B AFSCs the criteria to select the airmen who go direct-duty are based on availability of openings at technical school. The airmen graduating from basic training who have a guaranteed skills clause in their contract automatically go to technical training school (2). For those Category B airmen who do not have a skill guarantee, the deciding factor is whether or not the openings are available at technical school. If openings for them are not available, these airmen are sent as direct-duty assignees (2).

Out of the 16 Category B AFSCs, seven of them are civil engineering AFSCs (9). In Fiscal Year 87, 3,015 airmen in the 16 Category B AFSCs are projected to graduate from basic training. In this group are 1,308 airmen projected for the seven civil engineering AFSCs. There are 1233 airmen projected to go direct-duty for Fiscal Year 87; 511 of them will be in one of the seven civil engineering AFSCs (7: Amendment 3, 1-23). The remainder of the direct-

duty airmen will come from cross trainees. There are approximately 800 positions projected for the seven civil engineering AFSCs in Fiscal Year 87 to be filled by cross trainees (2).

The responsibility for training these direct-duty airmen rests with the unit training NCO. The training NCO trains the airmen according to the procedures established in AFR 50-23, On-the-Job Training, for 3-level upgrade training (8). As of the end of September, 1985, there were a total of 3,626 airmen actively enrolled in the OJT upgrade training for 3-level skill (3). This figure includes airmen in all 31 AFSCs from Categories B and C, but only those enrolled in the program at that time.

Constraints

The biggest constraint on expanding technical schools to train all airmen is people (2,4). This constraint is directly related to funds. In order to expand technical schools, funds to pay for instructors are required. Students also have to be funded. While at technical school, the students belong to ATC. Therefore, ATC has to pay the students until they graduate and transfer to another base (2).

With the current emphasis on keeping the Department of Defense (DOD) budget at a minimum, ATC can not get the required additional funds from Congress through the budget

process (2). The only available avenue for obtaining funds to expand technical schools is through the other major commands (2). The major commands would have to transfer funds, in the form of manyears, to cover the costs of instructors and students. For example, if the tecnnical school for interior electricians wanted to expand their school to include two instructors full-time and 30 additional students per class, the major commands would have to transfer 32 manyears (funded positions) to ATC to cover these costs.

Philosophies

There are two philosopnies centered around the direct-duty training method. The pro-direct-duty advocates believe that with current technology in the areas of computers and videodiscs, the quality of training airmen on the job is just as good as the training received at technical training school, at a much lower cost (4). These advocates claim that with increasing constraints on the budget each year, the number of AFSCs in Category B (eligible for direct-duty method) should be expanded to save costs (4).

In contrast, others believe that the direct-duty method actually costs the Air Force in the long run (1,4). The advocates of this view claim that the one-on-one training required and the length of time needed to train a

new airman on the job result in loss of productive time for both the trainer and the student (1). This loss of productivity is measured in costs using the current shop rate in which these individuals are assigned. In the long run, the pro-technical school advocates believe these costs far outweigh the costs associated with sending everyone to technical school. The staff at the Air Force Engineering and Services Center support the pro-technical school view (1). They strongly support this view because seven of the existing 16 Category B AFSCs are engineering AFSCs, and a large part of the training burden for direct-duty airmen falls to base level engineering squadrons.

III. Methodology

The methods used for this research were observation, personal interviews, and literature collection. The data from these methods were combined to determine the total costs of each training method.

Observation

The observation method involved categorizing airmen into eight cells. All first-term airmen in all seven Category B AFSCs at Wright-Patterson, Scott, and MacDill Air Force Bases were categorized into one of the eight cells. The cells are labeled as in the following table.

Method\Year	1	2	3	4
Direct-Duty				
Tech School				

Each airman was observed each morning and each afternoon on each day of the week for one week to determine the proportion of time that the airman was productive. This method was used because of the TDY limitation of one week at both Scott and MacDill Air Force Bases and to account for any time dependencies during the work week. Either a yes or a no was marked down for each observation

to indicate whether the airman was productive at the instant of the observation. The hypothesis tested was:

NULL HYPOTHESIS: There is no significant difference between the average percent productive time for the direct-duty airmen and the technical training school graduates.

ALTERNATE HYPOTHESIS: There is a significant difference between the average percent productive time for the direct-duty airmen and the technical training school graduates.

The Z-test statistic for differences between population proportions was used to test for any significant differences between average percent of productive time for direct-duty airmen versus technical school graduates (3).

The following criteria were used to classify the airmen as being productive. All other times were marked as non-productive.

1. Traveling to or from the worksite.
2. Setting up the work area or cleaning the work area, for example, setting up tools and materials prior to performing job.
3. Discussing the plans and drawings for the job.
4. Actually doing direct labor on the job; not watching, but participating.

The following test statistic for differences in population proportions was used:

Null Hypothesis: Ho: p1-p2 = 0

Alternate Hypothesis: Ha: p1-p2 NE 0

Test Statistic:

$$Z = (p1-p2)/\mathrm{sqrt}[p*q*(1/m+1/n)] \qquad (1)$$

where p1 is the average percent of productive time for technical training school graduates, p2 is the average percent of productive time for direct-duty airmen, m is the total number of observations of technical training school graduates, n is the total number of observations of direct-duty airmen, p is the weighted total percent of productive time for the entire sample, using the equation

$$p = (m/m+n)*p1 + (n/m+n)*p2 \qquad (2)$$

and q = 1-p.

Rejection Region: Reject Ho if the absolute value of the calculated Z is greater than or equal to Z(alpha/2), where Z(alpha/2) for an alpha of 0.05 is 1.960.

Interview and Literature Collection

The personal interview method involved interviewing the training NCOs and the shop supervisors for each of the seven AFSCs at each of the three bases. The objective was to determine how much time was needed to train the direct-duty airman to the same skill level as that of a technical school graduate.

The literature collection method involved obtaining costs figures, program descriptions, selection criteria,

and other data necessary to test the hypothesis. This data was collected from sources at USAF Headquarters, ATC Headquarters, and MPC. The data was collected by telephone interview.

Cost Comparison

The cost to train a direct-duty airman at base level was computed using the shop rates for each AFSC and the amount of time needed to train an airman to the same skill level as an airman graduating from technical training school. This cost was compared to the cost to send each airman to his respective technical training school to see if there was any significant difference. The costs to send one student to each of the seven technical training schools were obtained from the Analysis Training Cost Division at Headquarters ATC (5).

The method used to obtain the cost of each training method to the Air Force was to calculate the loss of benefit to the Air Force for work not accomplished due to training. To determine this loss of benefit, the actual benefit from an airman was calculated and then subtracted from an optimal benefit. The optimal benefit was the baseline used for comparison purposes, and was calculated by multiplying the total number of hours available during a work period, for example one year, times the shop rate for the shop where the airman was assigned.

Based on the findings from the observation portion of this research, there was no significant difference in the proportion of productive time for an airman in either training method for year groups two, three, or four. Therefore, the Air Force received the same amount of benefit from each airman regardless of training method because their work output was the same. To simplify the calculations, these three years were deleted from the cost calculations, leaving only the first year for the time period used in the cost calculations. Since all airmen coming into the service attend basic training for two months, the first two months of the year were also deleted to simplify the calculations, which left ten months as the time period.

Calculations were made for the actual benefits (or costs) gained by the Air Force from each training method for each AFSC sampled. These benefits were then subtracted from the optimal benefit for each AFSC to determine the cost (loss of benefit) to the Air Force for each method. The costs for both methods for each AFSC were then compared to determine if the direct-duty method of training cost the Air Force more money than technical training school.

To determine the cost of the technical training school method, the benefits from the ten month period were calculated. For the period of time that the airman was attending technical training school, the Air Force received

no benefits because the airman was not at a base working. However, the Air Force did incur the cost of the school itself. This cost was obtained from Headquarters ATC, as mentioned earlier. For the remainder of the ten months, the airman was at a base performing work at the productive rate found in the observation portion of this research, which was 0.533. The benefit, B, from this work was calculated as

$$B = 0.533 \times SR \times MH \times (10 - T) \qquad (3)$$

where

SR = average shop rate for the three bases sampled
MH = available manhours per month (8 hours per day x 21 days per month = 168 manhours per month)
T = course length of technical training school in months

The calculated benefit for the ten-month period was determined by subtracting the cost of the technical school from the benefit of the base-level work, B. The cost to the Air Force was then calculated by subtracting the calculated benefit from the optimal benefit, OB, which was calculated using $OB = SR \times MH \times 10$.

To calculate the cost of the direct-duty method, the benefits (or costs) for the ten-month period had to be determined. Based on the interviews in this research, during the first six months at a base the direct-duty airman received one-on-one training (only four months for the pavements specialist). During this time, either the

trainee or the trainer was productive while the other was non-productive, i.e., either the trainer was showing while the trainee was watching, or the trainee was working while the trainer watched to make sure the trainee was performing correctly. Because of this arrangement, there is a cost to the Air Force of one manhour for each hour of the work day.

Also discovered during the interview portion of this research was that because the trainer had to show the trainee how things were done, the projects required, on the average, 50% more time to complete than normal. Because of the extra time used for these projects, the Air Force lost the benefit of having other projects completed that would normally be completed. This loss of benefit equates to one manhour for each hour of the work day. The total amount of non-productive time to the Air Force is two manhours for each hour of the work day for the first six months at a base. The actual cost, C, is shown as C = 2 x SR x MH x 6.

For the remaining four months, the airman was working at the base at the productive rate found in the observation portion of the research, which was 0.833. The benefit here was calculated as B = 0.833 x SR x MH x 4 . Again the calculated benefit for the ten-month period was determined by subtracting the cost of the first six months from the benefit, B, associated with the last four months. The cost of the direct-duty method was then determined by subtracting the calculated benefit from the optimal benefit, OB.

The cost of each training method was calculated for each AFSC. Then the costs for both training methods were compared for each AFSC to determine if the direct-duty method cost the Air force more than the technical school method.

Conclusion

The objective of this research was not only to test the hypothesis at the three bases mentioned earlier, but also to design a research method that can be used successfully and accurately at all Air Force bases where direct-duty airmen are assigned. While the results from this research can be logically generalized to the Air Force as a whole, additional research with a large, randomly selected sample of bases needs to be done before the results can be statistically generalized. The methodology from this research, if successful, can be used for the expanded research. With more time a researcher can accomplish a longitudinal study of airmen from both training categories and statistically generalize the results throughout the Air Force.

IV. Findings and Analysis

Observation

The total number of observations were categorized into eight cells by year group and method of training. The number of observations that were labeled as productive were also categorized in a similar table. The following two tables show the figures found during the observation period.

Total Number of Observations

Method/Year	1	2	3	4
Direct-Duty	31	106	48	34
Tech School	122	112	40	41

Number of Productive Observations

Method/Year	1	2	3	4
Direct-Duty	26	64	31	22
Tech School	65	64	22	23

The following table shows the proportion of productive time for each year group and method of training.

Proportion of Productive Times

Method/Year	1	2	3	4
Direct-Duty	0.833	0.605	0.646	0.647
Tech School	0.533	0.571	0.550	0.561

Using the above proportions and the Z-test statistic for differences in population proportions, the following Z values were calculated and compared to Z(alpha/2) of 1.960 for an alpha level of 0.05. All Z values are shown in absolute form.

Year One: 3.029 > 1.960; Reject Ho. There is a significant difference in the proportion of productive time between training methods.

Year Two: 0.510 < 1.960; Do not reject Ho. There is no significant difference in the proportion of productive times between training methods.

Year Three: 0.916 < 1.960; Do not reject Ho. There is no significant difference in the proportion of productive times between training methods.

Year Four: 0.757 < 1.960; Do not reject Ho. There is no significant difference in the proportion of productive times between training methods.

Out of the four year groups observed, the only year group with a significant difference in proportion of time productive was the first. However, when looking at the

difference in sample sizes between the two training methods, it appears that the small size of the direct-duty sample may have influenced the test. If an equivalent number of sample observations were made, the proportion of productive times for direct-duty airmen may have been lower and closer to the range found among all other samples. The proportion of 0.833 is much higher than all other proportions found and appears to be an outlier. Therefore, the validity of this test may be suspect and further samples should be taken. On the other hand, if this proportion of 0.833 is valid, it may reflect a higher amount of actual hands-on training for the direct-duty airman. However, while the airman may be performing the work as he learns, the trainer is observing the airman work, which reflects a loss of productivity for the shop and the base.

Interview

Each of the foremen, superintendents, and squadron trainers was interviewed informally to determine methods used at base level to train direct-duty airmen, the advantages and disadvantages of technical training school and direct-duty training methods, and any problems associated with either method. The following is a list of the replies given by at least two of the individuals interviewed.

1. Graduates from technical training school have a basic knowledge of tools, equipment and parts when they arrive at their first duty station. They get the opportunity to work with most of the tools and systems in their respective fields at the school.

2. Technical training school gives the airmen a chance to learn the theory of how and why systems work. This enables the airmen to learn how to troubleshoot and repair systems better. Direct-duty airmen normally do not receive this type of training.

3. A lot of time is required to train a direct-duty airman at the base. It takes approximately six months to upgrade a direct-duty airman to his three-level skill in each AFSC except the pavements specialist, which requires only four months.

4. When training a direct-duty airman, a one-on-one training method is used. Because time has to be taken to show the airman how to troubleshoot, repair, or construct an item, the task takes longer to complete than if a skilled craftsman were to work at his normal pace. On the average, a minimum of 50% more time is required to complete the task.

5. There are numerous occasions when the shop has command interest projects which require using the best-skilled craftsmen from the shop. This leaves the least-skilled craftsmen from the shop to provide the training for the direct-duty airmen.

6. When the shop is short-handed, the foreman can not spare the craftsmen to take the necessary time to train direct-duty airmen on a one-on-one basis. The airmen become non-productive and essentially follow others around trying to learn without getting in the way.

7. Technical training school graduates as well as direct-duty airmen are not considered productive members of the shop until they upgrade to their five-level. It takes the direct-duty airman six months longer to upgrade to the five-level. More time is required of the shop supervisor to train a direct-duty airman versus a technical school graduate.

8. The supervisor spends much of his valuable time checking up on projects to which direct-duty airmen are assigned to ensure they are receiving proper training and to ensure the project does not fall behind schedule.

9. Foremen do not allow airmen to work the Do-It-Now (DIN) vehicles or pull standby by themselves until they upgrade to their five-level. Since it takes the direct-duty airman six months longer to upgrade, the shop foreman has to wait that much longer before he can use the airman on standby or DIN. In the interim the foreman will pair the airman with qualified craftsmen on standby and DIN to gain some experience in these areas.

10. Technical school graduates get exposed to most of the systems and equipment in their field at school, whereas

direct-duty airmen receive training only on the systems and equipment available at their base. When direct-duty airmen get reassigned to a new base, they may see new systems and equipment that are totally unfamiliar to them. The technical school graduate, on the other hand, has at least seen the system or equipment at technical school and is somewhat familiar with them.

11. Technical training school graduates receive more detailed safety instruction that is consistent throughout the program. Base level safety training for direct-duty airmen varies from base to base.

12. Direct-duty airmen do not receive their course books for their three-level for approximately six-to-eight weeks after their arrival. During this time they are trying to learn by following others around. They get frustrated because they do not have the books to study and reference.

13. Technical training school graduates are afforded the opportunity to tear apart and work with training equipment. Bases can not afford the elaborate training devices that technical training schools have, and craftsmen can not turn off equipment to tear it apart and show the direct-duty airmen how it works and what the various parts look like.

14. It can be difficult for shop foremen and squadron training NCOs to measure the progress of a trainee during

his training. The only measurement tool available is the end-of-course exams. It is too late to try to help an airman after he has failed this exam. At technical training school the instructor is better able to measure the performance of his students.

15. Direct-duty airmen, with the exception of cross-trainees, are normally coming right out of high school, which has a classroom environment. Airmen do not know how to discipline themselves to study on their own in the correspondence environment of base-level on-the-job training.

Technical School Costs

The costs to send one airman to each of the seven technical training schools were obtained from the Analysis Training Cost Division at Headquarters ATC. The costs are listed as total cost per student and the variable cost per student. The variable cost is also the cost to send one additional student to school. The following table shows these costs, the number of students graduated in Fiscal Year 1985, and the length of the course in days.

Technical School Costs

AFSC	Total	Var	# Students	Length
54230	8653	5904	218	40
54532	8787	5761	179	45
55130	4519	3067	197	18

55230	6027	3780	231	27
55231	5178	3267	62	23
55235	6850	4404	163	34
55530	8915	5845	93	45

The current total cost for the airmen who attended technical training school for Fiscal Year 1985 is $8,008,388. The amount of money needed to send all airmen to technical training school during this same time period was $13,268,049. Additional funds of $5,259,661 were needed to allow all airmen to attend technical training school. Because of the lack of funds from Congress, these funds would have to come from individual major commands in the form of manyears (2).

Cost Comparison

The cost to the Air Force was calculated for each training method for each AFSC except for 55530. AFSC 55530 did not have a calculated shop rate, which was needed to determine the cost differences in the methodology. The table below shows the results of the cost calculations. In each case, the direct-duty method cost the Air Force more than the technical training school method.

For each of the AFSCs the following average shop rates, technical training school course lengths, and student costs were used in the calculations.

54230: $22.71, 2 months, $5832 per student
54532: $18.11, 2.25 months, $6376 per student
55130: $16.97, 1 month, $3450 per student
55230: $19.82, 1.32 months, $4581 per student
55231: $19.82, 1.14 months, $3949 per student
55235: $19.82, 1.64 months, $5233 per student

Cost Comparison Table

AFSC	Cost DDA Method	Cost TS Method	Cost Comparison
54230	71,224	27,716	43,508
54532	56,797	24,233	32,564
55130	37,068	18,284	18,784
55230	62,160	22,474	39,686
55231	62,160	21,522	40,638
55235	62,160	23,694	38,466

As shown above, the direct-duty training method costs thousands of dollars more to the Air Force than sending airmen to technical training schools.

Analysis

The methodology used in this research is not ideal. Because of time and money limitations, a longitudinal study could not be performed. The method of instantaneous observations may not be valid. Trying to determine the

productivity of airmen requires longer periods of observation, not instantaneous observations. Observing airmen for only one week also was not enough time to truly observe the training methods or the productivity of each airman. The proportions of productive times may not be accurate. A larger sample and longer observation periods over the course of several months may give a more accurate picture of the productivity.

The interview method provided a better method of determining the training methods used at each base than the observation method. Another benefit from this method was the discovery of numerous intangibles that could not be seen during the observation method. These intangibles were listed in the interview portion of the findings. The interview method, however, depended on the memories of the foremen interviewed for information such as the extra time needed to complete projects because a direct-duty airman was being trained. While much agreement existed, there were also many discrepancies found among the statements made by the foremen. Actual observation of the events described by the foremen is required to validate their statements. Again this requires the time and money to perform a longitudinal study at numerous bases.

Even with the weaknesses discussed here, enough valid information was gathered to make a reasonable cost comparison between training methods. The direct-duty

airmen did require one-on-one training which resulted in the loss of productivity, and the projects did take longer to complete. These results were not only mentioned by the foremen, but were also observed during the observation period.

V. Conclusions and Recommendations

Conclusions

Based on the large cost differences per airman for the two training methods, and the statements concerning the problems associated with the direct-duty method, it was concluded that each airman in civil engineering should be sent to technical training school to receive his three-level before being sent to a base to work. The direct-duty method did not save the Air Force any money; instead it cost the Air force more money to use this training method.

The direct-duty method resulted in loss of productivity for a six-month period for both the worker and the trainer. The bases can not afford this loss with the current work loads. In some instances, the shop was short-handed and needed skilled workers that could pitch in and help. Instead, the shop foreman had to schedule a trainer to work with the new airman to train him for his three-level. As stated by many foremen, the technical training school graduate has at least a knowledge of equipment, terminology, and what the systems look like. This allows the airman to start working immediately and become a productive member of the shop.

Recommendations

With the large costs associated with using the direct-duty training method, it is recommended that the Air Force find some way of transferring the needed manyears to ATC to accommodate all airmen in civil engineering. Each of the seven Category B AFSCs should be upgraded to Category A. By doing so, the Air Force can save between $18,000 and $43,500 per airman entering into one of the seven AFSCs.

Because of the small number of bases sampled, a follow-on study should be accomplisned. Two types of studies are possible. The first is a survey of all foremen in the seven AFSCs to validate the findings from the interviews of this research. Questions can be developed for each of the areas discussed in the findings. As a minimum, the following areas should be examined.

1. Time needed to upgrade a direct-duty airman to the three-level skill.
2. Amount of one-on-one training required for all airman arriving at a base.
3. Amount of time the supervisor spends checking up on tne trainees.
4. Length of time required to complete projects wnen training a direct-duty airman as compared to the normal time required by a skilled craftsman.
5. The career progression of a direct-duty airman as opposed to the technical training school graduate.

Does the direct-duty airman require more time to upgrade to a higher skill? Does the direct-duty airman have the same promotion potential?

6. Advantages the technical training school graduates have due to the hands-on training they receive on training modules and equipment.

7. Any special training or equipment used by bases to train direct-duty airman.

As stated earlier, this is just a minimum list of subjects to be investigated. I recommend that this type of follow-up study be accomplished by another AFIT student.

The second type of study possible is a longitudinal study performed at a large number of Air Force bases. This study should contain observations of new airmen arriving at base level from technical training school as well as direct-duty assignees. These observations should not be instantaneous, but should cover long periods of the work day. The observations should continue for the first year of active duty for each airman.

This type of study should concentrate on determining the actual time required to train a direct-duty airman, the actual methods used to train airmen, the amount of one-on-one training actually required, the actual productivity of each airman throughout the period, and the documentation of the problems associated with each method. This information can be used to validate the information and conclusions

from this research. The large sample size will also allow the results to be statistically generalized to the Air Force. It is recommended that this type of research be conducted by a research firm by government contract.

The objective of this research was to develop a methodology to use for future research. The results from this study, while useful, cannot be statistically generalized due to the small number of bases sampled. The interview method and the observation method were both used with some success. With minor modifications, both methods of data gathering can successfully be used for larger samples in future studies.

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VITA

Captain Keith E. Smith was born on 20 July 1958 in Jefferson City, Missouri. He graduated from high school in Jefferson City in 1976 and attended the University of Missouri in Columbia, Missouri. He received a Bachelor of Science degree in Civil Engineering in 1980 and was commissioned in the Air Force through the ROTC program. His first civil engineering assignment was as a contract programmer in the 2849th Civil Engineering Squadron at Hill Air Force Base, Utah, from April 1981 to May 1983. He then served as the Chief, Readiness and Logistics in the 43d Civil Engineering Squadron at Andersen Air Force Base, Guam, until April 1984 when he became the Chief, Resources and Requirements. He became Chief, Operations and Maintenance in February 1985 and remained in this position until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1985.

Permanent address: Rt 5 Quail Valley Lake
Jefferson City, Missouri 65101

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Seven Air Force Specialty Codes (AFSC) in civil engineering are coded Category B for training. Thus 50% of all airmen entering each of these AFSCs attend technical training school, while the remaining airmen are sent direct-duty to their first assignment to be trained by the squadron. Air Force Engineering and Services Center (AFESC) believes that training airmen at the base level costs the Air Force money in the long run due to loss of productivity. First-term airmen were observed at three bases to determine if there was any significant difference in the proportion of productive time between technical school graduates and direct-duty airmen. Foremen and trainers were interviewed to determine training methods for the direct-duty airmen as well as any problems associated with either training method. The results of the research show that there is no significant difference between the proportions of productive times for the two training methods for years two, three, and four of the airmen's first term. There was a significant difference for airmen in their first year, with direct-duty airmen being more productive. The costs for each method were also obtained and compared. In each AFSC, the Air Force would have saved money if all airmen had been sent to technical training school. These cost savings ranged from $18,784 to $43,508 for each airman entering one of the seven AFSCs. Based on the findings from this study, all airmen entering civil engineering should be sent to technical training school.